CLAIMS

1. A gate for quantum information processing comprising:

at least two units each having a plurality of states useable for representing quantum information; and

an electron system having at least a first state and a second state, which states provide different amounts of interaction between said units, wherein the electron system is switchable by means of electromagnetic radiation between the first and second states to control the interaction between the units.

2. A gate according to claim 1, wherein the information-representing units are systems having nuclear spin or electronic spin or are reorientable defects.

3. A gate according to claim 1 or 2, wherein the first and second states are the ground state and an excited state of the electron system.

4. A gate according to claim 1, 2 or 3, wherein the second state has a larger spatial extent than the first state.

5. A gate according to any one of the preceding claims, wherein when the electron system is in the first state the interaction between the units is substantially eliminated and when in the second state the interaction is enhanced.

6. A gate according to any one of the preceding claims, wherein the electron system comprises one or more electrons provided by at least one donor atom.

7. A gate according to claim 6, wherein the at least one donor atom comprises a deep-donor.

8. A gate according to any one of claims 1 to 5, wherein the electron system comprises one or more holes resulting from at least one acceptor atom

receiving an electron.

9. A gate according to claim 8, wherein the at least one acceptor atom comprises a deep-acceptor.

10. A gate according to any one of claims 6 to 9, wherein the or each donor or acceptor atom is located between the information-representing units.

11. A gate according to any one of claims 6 to 10, wherein the or each donor or acceptor atom is separated from the information-representing units by an interface.

12. A gate according to any one of claims 1 to 5, wherein the information-representing units comprise donor atoms, of which the nuclear spin states are useable for representing quantum information, and the electron system comprises one or more electrons from said donor atoms.

13. A gate according to any one of claims 1 to 5, wherein the information-representing units comprise acceptor atoms, of which the nuclear spin states are useable for representing quantum information, and the electron system comprises one or more holes provided by said acceptor atoms.

14. A gate according to any one of the preceding claims, wherein the energy difference between the first and second states is greater than the energy associated with the information of the information-representing units.

15. A gate according to any one of the preceding claims, wherein the energy difference between the first and second states is greater than 0.025 eV.

16. A gate according to any one of the preceding claims, wherein the gate is provided in a nanocrystal.

17. A gate according to any one of claims 1 to 15, wherein the information-representing units are provided in an Si channel in an SiO_2 matrix.

18. A gate according to any one of the preceding claims, wherein the electromagnetic radiation is time dependent, preferably a laser pulse.

19. An array of gates, for quantum information processing, comprising:

means for applying at least one field over the array, which field shifts the energy of transitions used to control states, and wherein the or each field varies spatially, so that different portions of the array are selectively controllable.

20. An array of gates according to claim 19, wherein the at least one field comprises one or more of electric field, magnetic field and stress field.

21. An array of gates according to claim 19 or 20, wherein a stress field is appliable externally as one of an ultrasonic or acoustic pulse.

22. An array of gates according to claim 19, 20 or 21, wherein a stress field is the result of misfit dislocations.

23. An array of gates according to claim 19, 20, 21 or 22, wherein more than one field is appliable, and the directions in which the fields vary spatially are different from each other.

24. An array of gates according to any one of claims 19 to 23, wherein at least one of the fields is time-dependent.

25. An array of gates according to any one of claims 19 to 24, wherein selective control of qubit-qubit interaction or intra-qubit control is enabled.

26. A method of selectively controlling gates in an array of gates, for quantum information processing, comprising:

applying at least one field over the array, which field shifts the energy of transitions used to control states, and wherein the or each field varies spatially, so that different portions of the array are selectively controllable.

27. A method of fabricating a gate comprising the steps of:

(1) Creating a region of silicon by low-energy electron irradiation of optical fibre composed of SiO_2;

(2) Absorbing on that Si a molecule including two atoms which can function as donors in Si and which have a specific interatomic spacing in that molecule;

(3) Oxidising the surface, so as to burn off the undesired atoms from the molecule and to oxidise the Si to SiO_2.

28. A method according to claim 27, wherein the molecule is a buckeyball pair, or a rigid organic molecule.